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Jon A. Moore
Division of Vertebrate Zoology
Peabody Museum of Natural History
Yale University
New Haven, CT 06520

Celia Lewis
Division of Vertebrate Zoology
Peabody Museum of Natural History

Michael R. Anderson
Division of Vertebrate Zoology
Peabody Museum of Natural History



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Diet of a Great Horned Owl (*Bubo virginianus*) on a Small Coastal Connecticut Island

Jon A. Moore
Celia Lewis
Michael R. Anderson

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Abstract

We assessed the diet of a single great horned owl residing on a small coastal island in Long Island Sound by examining the contents of pellets and other materials found below roosts. This owl fed on an unusually broad array of prey items, especially birds, providing insight into the foraging strategies used.

Keywords

Owl, diet, prey, foraging behavior, winter roosts.

Introduction

Great horned owls (*Bubo virginianus* Gmelin) are well known as fierce predatory birds. Although preferred food items usually consist of rodents or rabbits, as a species great horned owls eat a wide array of animals, including other mammals, such as porcupines, bats, opossums and skunks; birds of all sizes, such as songbirds, ducks, hawks and other owls; snakes (even venomous species); frogs; fishes; and invertebrates such as crayfish, scorpions, beetles and grasshoppers (Billings 1990; Campbell and Lack 1985;

Errington et al. 1940; Voous 1989). Within this varied diet most individual *B. virginianus* usually concentrate on only a few large prey, depending on what is available (Billings 1990), and certain individuals behave as dietary specialists by focusing on specific food items (Baker 1962; Hayward et al. 1993).

We report here on an individual great horned owl that made its fall and winter roosts on Horse Island in Long Island Sound, 2.5 km offshore from Stony Creek in Branford, Connecticut, from 1992 through 1996. Horse Island is small (6.9 hectares) and almost completely wooded with small stands of beech, pine and cedar trees among mixed scrub and hardwoods. A number of suitable roosting sites are available in pine trees and vine-covered hardwoods. In most places the periphery of the island features a wide rocky intertidal zone. This island is uninhabited by humans and is undisturbed during the late fall and winter months.

Materials and Methods

The owl typically arrived on the island in October or November and left by the following April. The owl was first noticed on the island in the winter of 1992–1993.

Table 1

Prey species documented from pellets and other materials.

Mammals

<i>Rattus norvegicus</i> (Berk.)	brown rat
<i>Microtus pennsylvanicus</i> (Ord)	meadow vole

Birds

<i>Podiceps auritus</i> (L.)	horned grebe
<i>Anas platyrhynchos</i> L.	mallard
<i>Anas rubripes</i> Brewster	American black duck
<i>Bucephala</i> cf. <i>clangula</i> (L.)	goldeneye
<i>Mergus</i> cf. <i>serrator</i> L.	merganser
<i>Aythya</i> cf. <i>marila</i> (L.)	scaup
<i>Branta canadensis</i> (L.)	Canada goose
<i>Cygnus olor</i> (Gmelin)	mute swan
<i>Larus delawarensis</i> Ord	ring-billed gull
<i>Larus argentatus</i> Pont.	herring gull
<i>Larus marinus</i> L.	greater black-backed gull
<i>scolopacid</i>	sandpiper
<i>Ardea herodias</i> L.	great blue heron
<i>Zenaida macroura</i> (L.)	mourning dove
<i>Ceryle alcyon</i> (L.)	belted kingfisher
<i>Quiscalus quiscula</i> (L.)	common grackle
<i>Cardinalis cardinalis</i> (L.)	northern cardinal
<i>Carpodacus mexicanus</i> (Muller)	house finch
<i>Zonotrichia</i> cf. <i>albicollis</i> (Gmelin)	sparrow
<i>Junco</i> cf. <i>hyemalis</i> (L.)	junco
<i>Passer domesticus</i> (L.)	house sparrow
<i>Corvus brachyrhynchos</i> Brehm	American crow

Reptiles

<i>Thamnophis sirtalis</i> (L.)	garter snake
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Fishes

<i>Stenotomus chrysops</i> (L.)	scup
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Invertebrates

<i>Triodopsis albolabris</i> (Say)	white-lipped forest snail
<i>Carabus nemoralis</i> Muller	ground beetle
<i>Libinia</i> sp.	spider crab

We assume that the same owl returned to the island on a regular basis for at least four winters because the same roosts and feeding sites around the island were utilized each year. Presumably this owl spent the spring through fall somewhere on the mainland, since it was absent from the island during that time. Its main roosting site was a large pine in a small grove on the northeast end of the island. Feeding sites were scattered over the island, usually in low branches of pine or hardwood trees.

We collected pellets from underneath regularly used roost and feeding sites on Horse Island at the end of each winter from 1993–1996. Owl pellets are distinguishable from those of other birds of prey by their large size, compact and solid appearance, and light grayish coloration. We may have missed some pellets that decomposed or were removed by other animals before we searched the island each year. We were also unable to search nearby Outer and Pott Islands for pellets, so this study may actually under-represent the true diversity of food items consumed by this individual.

The pellets were dissected and skeletal remains and feathers were compared to osteological material and bird skins from the Division of Vertebrate Zoology collection at the Peabody Museum of Natural History at Yale University. Prey items, especially birds, were usually identified from fragmentary remains. When precise species identification was not possible, identification was made to the lowest possible taxonomic level, in most cases to genus, and referred to the most similar wintering species (e.g., *Aythya* cf. *marila* (L.)). Pellet contents have been deposited in the Division of Vertebrate Zoology at the Peabody Museum of Natural History.

Results and Discussion

A total of 151 pellets and other remains were collected at the end of the winter in 1993, 1994 and 1995. Another seven pellets were collected in 1996, but are excluded from the following analysis. Table 1 lists the 29 prey species we documented and Table 2 provides a full compilation of pellet contents and other remains examined. Great horned owl pellets accumulate at a rate of one or two per day (Austing and Holt 1966; Billings 1990) and represent the previous night's meals. Given that rate of accumulation, we clearly did not recover all of the pellets from any single winter.

In addition to pellets, other evidence of foraging behavior was collected from underneath regularly used roosting and feeding sites. Isolated specimens of a forest snail (*Triodopsis albolabris* (Say)) were found under two feeding roosts. These specimens were broken open in the same place, and manner, as snail shells recovered from within pellets. We presume these shells were discarded, rather than ingested, by the owl. Eggs of ducks (*Anas* L. spp.) and Canada goose (*Branta canadensis* (L.)) were found broken open, but largely intact, and lying directly below two feeding sites. Canada geese, mallards (*Anas platyrhynchos* L.) and black ducks (*Anas rubripes* Brewster) all are known to nest on Horse Island and it is possible that this owl was occasionally stealing eggs from nests in the late winter (according to Voous [1989] great horned owls do make night raids on nests).

The opercula of periwinkle snails (*Littorina* spp.) were recovered only from those pellets that also contained rat remains. Periwinkle snails are marine intertidal residents and quite small. Periwinkle shells were never recovered below the roosts

Table 2

Owl pellets and items found discarded below feeding roosts. The list gives the field number and description of the general contents, including minimum number of individuals of each food item based on number, kind and sizes of bones found in the pellet.

Field no.	Description
Fall/winter of 1992–1993	
I-1	Kingfisher pelvis and leg bones; small crab pieces, small fish bones.
I-2	Anterior halves of 2 subadult brown rats.
I-3	Anterior halves of 2 subadult brown rats; skull and neck bones from duck (<i>Anas</i> sp.).
I-4	Mostly white feathers with fragments of bones from large bird; fragments of brown rat bones.
I-5	Shoulder bones of scaup (<i>Aythya</i> sp.); many dark feathers.
I-6	Posterior bones from an adult and anterior halves of 2 subadult brown rats; many periwinkle opercula.
I-7	Wing bones of herring gull; white feathers.
I-8	Various bones from 2 juvenile rats; many periwinkle opercula.
I-9	Various bones from 1 subadult rat.
I-10	Bird feathers, ribs and other bird bone fragments.
I-11	Skull and shoulder of 1 adult brown rat.
I-12	Anterior portion of 1 subadult brown rat; periwinkle opercula and crustacean fragments.
I-13	Lower leg and foot of greater black-backed gull; large white contour feathers.
I-14	Various bones from 3 subadult brown rats; distal wing bones of herring gull; scup (fish) neurocranium.
I-15	Parts of 1 adult, 2 subadult and 1 juvenile brown rats; head of humerus of herring gull; pieces of bones from large bird; periwinkle opercula.
I-16	Portions of 4 juvenile brown rats; sternum, pelvis and foot of scaup (<i>Aythya</i> sp.); a few ground beetle parts; periwinkle opercula.
I-17	Skull and shoulder fragments of greater black-backed gull.
I-18	Skull of adult brown rat.
I-19	Pieces of 1 adult and 1 juvenile brown rats; periwinkle opercula.
I-20	Pieces of 1 subadult brown rat.
I-21	Vertebrae and ribs of rat; periwinkle opercula.
I-22	Skull and shoulders of 2 subadult brown rats; white bird feathers and piece of skin.
I-23	Jaws of adult brown rat; skull and vertebrae of Canada goose.
I-24	Femur head and pelvic acetabulum from unidentified large bird.
I-25	Duck (<i>Mergus</i> ?) coracoid and bird feathers.
I-26	Leg bones of 2 different-sized rats; periwinkle opercula.
I-27	Entire subadult brown rat; periwinkle opercula.
I-28	Brown rat bones; 1 large bird vertebra.
I-29	Brown rat bones.

Continued

Table 2 continued

Field no.	Description
I-30	Skull of adult brown rat.
I-31	Fragment of scapula of rat; pieces of long bones of large bird; quills of large feathers.
I-32	Fragments of rat pelvis; feathers and fragments of bird bones.
I-33	Feather quills and bird ribs; snake vertebrae and lower jaws.
I-34	Leg bones of subadult rat.
I-35	Skull and shoulder of subadult brown rat.
I-36	Vertebrae and long bones of great blue heron; various bones from 5 or more small fishes.
I-37	Skull and vertebrae of brown rat; feathers.
I-38	Bones from anterior half of subadult brown rat; ground beetle parts.
I-39	Various bones from 2 different-sized rats.
I-40	Various bones from 2 juvenile rats.
I-41	Vertebrae and skull fragments from rat; feathers and fragment of bird vertebra.
I-42	Wing bones of goldeneye duck (<i>Bucephalus</i> sp.); quills of large feathers.
I-43	Jaw and skull fragments of rat.
I-44	Skull of brown rat.
I-45	Bones from posterior half of rat.
I-46	Sternum, ribs and dorsal vertebrae of goldeneye (<i>Bucephalus</i> sp.); bone fragments; feathers.
I-47	Skull fragments of rat.
I-48	Various bones of rat.
I-49	Various bones of rat.
I-50	Duck caudal vertebra; fragments of bird bones; sculpin fish bones.
I-51	Gull wing bones and primary feathers (<i>Larus</i> sp.).
I-52	Various rat bones.
I-53	Fragments of bird bones.
I-54	Bones from anterior half of rat; periwinkle opercula; fragments of bird bones; feathers.
I-55	Large bird vertebra and fragments.
I-56	Large bird vertebra and fragments; many feathers; ground beetle parts.
I-57	Numerous ground beetle parts.
I-58	Small bird vertebrae; feathers; numerous ground beetle parts.
I-59	Large bird ribs; snake vertebral column and keeled scales, from garter snake.
I-60	Various bones of a rat.
I-61	Cardinal feathers.
I-62	Intact leg bones of great blue heron found discarded below feeding roost.

Continued

Table 2 continued

Field no.	Description
Fall/winter 1993–1994	
2-1	Greater black-backed gull vertebrae; mourning dove bones; mixed birdseed.
2-2	Feathers and fragments of sternum.
2-3	Skulls of 2 brown rats; few feathers.
2-4	Skull and other bones of black duck.
2-5	Skull of brown rat.
2-6	Nearly intact hindlimbs of rat.
2-7	Skull of brown rat.
2-8	Fragments of shoulder bones of bird; feathers.
2-9	Few rat bones; bird bone fragments and feathers.
2-10	Few rat bones; junco (<i>Junco cf. hyemalis</i>) sternum and pelvis; pieces of long bones of gull or duck; shell debris, crustacean fragments, small fish vertebrae.
2-11	Most bones of subadult rat.
2-12	Proximal wing bones of crow.
2-13	Distal wing bones of crow.
2-14	Mourning dove leg bone; 2 vertebrae from duck (<i>Anas cf. platyrhynchos</i>); other bird bone fragments.
2-15	Duck (<i>Anas</i> sp.) vertebra and bone fragments.
2-16	Coracoid of large bird; vertebrae of smaller songbird; feathers and bone fragments.
2-17	Skeleton of vole.
2-18	Rat pelvis; bird fragments.
2-19	Bones from posterior half of duck (<i>Anas cf. rubripes</i>), including intact foot.
2-20	Herring gull vertebrae and coracoid; quills of large feathers; bird bone fragments.
2-21	Skulls and leg bones of 2 rats; periwinkle opercula.
2-22	Herring gull leg bones.
2-23	Ringbill gull leg and wing bones; marine snail shells.
2-24	Posterior body of rat.
2-25	Few rat bones; sternum and vertebrae of crow; lots of black feathers.
2-26	Bird bone fragments; feathers of mourning dove?
2-27	Bird bone fragments; feather quills.
2-28	Rat bones; cardinal beak.
2-29	Bird feathers; fragment of carpometacarpus.
2-30	Bird feathers and bone fragments.
2-31	Large bird with white feathers plus sternum and ribs, possibly gull; bill, coracoid, wing and leg bones of house sparrow; sternum fragment and long bones from jay-sized bird.
2-32	Bones from posterior half of rat.

Continued

Table 2 continued

Field no.	Description
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2-33	Bones from 3 rats; vole lower jaw; various sparrow bones; dorsal vertebrae and pelvis of duck.
2-34	Fragment of rat skull.
2-35	Various bones of subadult rat.
2-36	Dorsal vertebrae and ribs of duck (<i>Anas</i> sp.); marine snail shells, crab fragments and polychaete worm jaws.
2-37	Bird quills and ribs.
2-38	Pieces of duck (<i>Anas</i> sp.) leg bones and vertebra.
2-39	Feathers and broken bird vertebrae.
2-40	Pelvis and tail bones of subadult rat.
2-41	Intact foot and broken leg bones from duck (<i>Anas</i> sp.).
2-42	Intact horned grebe foot; white feathers and bird bone fragments.
2-43	Bones from posterior half of adult rat body.
2-44	Bones from anterior half of subadult brown rat.
2-45	Bones from posterior half of subadult rat.
2-46	Sternum, beaks and limb bones from 5 sparrows (<i>Zonotrichia</i> cf. <i>albicollis</i>); few bones from juvenile rat; tarsometatarsus from horned grebe.
2-47	Intact herring gull head.
2-48	Pellet lost.
2-49	Lower bill of juvenile herring gull found discarded below a feeding roost.
2-50	Lower jaw, various bones and bird band from cardinal (this cardinal was banded on Horse Island the previous year).
2-51	Intact leg and pelvis of herring gull found stripped of flesh and discarded below feeding roost.

Fall/winter 1994-1995

3-1	Part of rat skull; skull bones from at least 2 voles; 3 forest snail shells; beetle parts.
3-2	Many beetle parts; pelvis and limb bones of 1 vole.
3-3	Lower jaw of brown rat; 1 forest snail shell; mourning dove feathers.
3-4	One entire vole.
3-5	Numerous beetle parts; few bones from vole.
3-6	Two skulls and various limb bones from voles; few beetle parts.
3-7	Brown rat skull; semi-intact foot plus distal humerus head of duck (<i>Anas</i> sp.); scolopacid (sandpiper) tarsometatarsus.
3-8	Mute swan foot discarded below feeding roost.
3-9	Various bones of rat.
3-10	Numerous beetle parts; skull and limb bones from at least 4 voles.
3-11	Herring gull skull discarded below feeding roost.

Continued

Table 2 continued

Field no.	Description
3-12	Pelvis and legs of rat; skulls and other bones from 2 voles.
3-13	Skulls and various bones from 2 brown rats.
3-14	Various bones of rat; few bones from a vole.
3-15	Many beetle parts; bones from a vole; 1 forest snail shell.
3-16	Anterior half of rat; 2 pieces of beetle.
3-17	Few bones from 1 subadult and 1 juvenile rat.
3-18	Various bones from posterior half of rat.
3-19	Few bones from 1 subadult and 1 juvenile rat.
3-20	Bones of 1 juvenile rat; periwinkle opercula.
3-21	Leg bones of 1 juvenile rat; skull and limb bones of 1 vole; beak and sternum of house finch.
3-22	Skull of vole; pelvis and humerus of rat.
3-23	Lower jaws and limbs of 2 juvenile rats; bones of 2 voles; 4 beetle parts.
3-24	Bones of juvenile rat.
3-25	Bones of juvenile rat.
3-26	Bones of juvenile rat.
3-27	Bones of juvenile rat; insect wings.
3-28	Bones of juvenile and adult rat; few beetle parts.
3-29	Bird feathers.
3-30	Spider crab carapace found discarded below feeding roost.
3-31	Seven forest snail shells found discarded below feeding roost.
3-32	One mallard or black duck egg opened at one end and discarded below feeding roost.
3-33	One Canada goose egg opened at one end and discarded below feeding roost.
3-34	Common grackle feathers found discarded below feeding roost.
3-35	Mourning dove feathers found discarded below feeding roost.

or within the pellets, and hence may represent dietary remains from the rats that the owl ingested. This suggests the owl may have foraged on rats caught out in the open on the extensive rocky intertidal zone surrounding the island.

A few additional items in the pellets were excluded from the prey list. For instance, one of the pellets with great blue heron (*Ardea herodias* L.) remains also had numerous vertebrae from very small fishes; it is unlikely the owl itself caught

these fishes. In another case, a pellet with mourning dove remains also contained mixed birdseed resembling typical feeder mixture, suggesting the dove fed somewhere off the island before being caught by the owl. Similarly, marine snails, crustacean fragments and polychaete worm jaws occasionally appeared in pellets with gull or duck remains. These examples are all interpreted as remnants of food items of the owl's prey.

Great horned owls are also known to

scavenge carrion, especially in winter (Voous 1989). A few taxa collected from pellets or from below feeding areas on Horse Island indicate that on occasion the owl was probably scavenging carcasses from the shoreline. A dismembered leg from an adult mute swan was found below one feeding roost. It seems unlikely that the owl killed an adult swan, but carcasses of these birds have washed up on the island shore from time to time. One pellet contained the neurocranium of a marine fish, but no other parts of that fish. Remains of a spider crab carapace were also found below a regularly used feeding roost.

Several pellets were almost entirely composed of carabid beetle remains. This owl apparently discovered where on the island to find large quantities of these beetles, which are not very active in late fall and winter. Beetle remains were very abundant in pellets from the third winter.

Small mammals (e.g., voles and rats) usually make up 66% to 97% of the diet of great horned owls in Connecticut, and birds (e.g., green backed heron, *Butorides striatus* (L.)) typically make up only 5% to 6% (Billings 1990; Bosakowski et al. 1989). Great horned owls also tend to select the largest available prey, but will alter their diet in response to seasonal changes in prey availability (Billings 1990; Craighead and Craighead 1969). Given this, the diet of the owl studied on Horse Island displayed a number of interesting features in its feeding. In the first winter (1992–1993), rat remains were found in 66% of the pellets, but no vole remains were found, whereas birds were found in 54% of the pellets and most of these birds were large-bodied (e.g., ducks, gulls, goose and heron). In the second winter (1993–1994), rats were found in 41% of the pellets, voles appeared in 4%, and

birds in 72% of the pellets, the latter including a number of smaller species (e.g. sparrows, dove, cardinal). By the third year (1994–1995), rats were in 57% of the pellets, voles in 34%, and birds in 26% (e.g., dove, grackle, house finch); scavenged remains, beetles and snails were also in a larger proportion of the pellets (29%). Broken duck and goose eggs were found under the roosts that year, too. The trend over the three winters appears then to be towards smaller prey and more different kinds of foodstuffs. The following winter (1995–1996) only a few pellets were found, suggesting that the owl returned briefly and then abandoned the island; perhaps it had too much difficulty finding prey during that more severe winter.

There were difficulties in determining the actual number of prey items consumed from the pellets. Many prey items were not swallowed whole and larger prey items (e.g., gulls or ducks) appear to have been dismembered and eaten over the course of several days. A number of pellets contained just feathers and sternal fragments, as if the meal consisted of mostly breast musculature. Some pellets included multiple prey items, indicating a number of feeding events (e.g., one pellet contained both seagull vertebrae and the legs and pelvic bones of a dove). Even some of the pellets with rat remains appeared to have bones from just the posterior or anterior half of the rat.

One other point worth mentioning regards the impact of the owl on the island's fauna. Kingfishers were known to nest on Horse Island prior to the owl's arrival. A number of kingfisher nesting burrows were in a muddy cliff on the east side of the island. After the arrival of the owl, kingfishers were completely absent from the island. It may be that the owl's

activities frightened away the kingfishers, but pellet analysis shows that at least one kingfisher fell prey to the owl as well. It is unknown whether the owl had a similar effect on other prey species inhabiting Horse Island.

The small size of Horse Island and the seasonal scarcity of animals likely limited the food resources available to this owl. This probably forced this particular great horned owl into feeding on a wider variety of prey species, especially birds, than is typical for a single individual of this species. Birds made up a large share of the food items, with at least 22 species represented in recovered remains. The diet also changed to greater numbers of smaller prey after the first winter.

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